sat-nms LBRX

L-Band Beacon Receiver

User Manual

Version 2.0 / 2011-11-10

© Copyright
SatService Gesellschaft für Kommunikatiosnsysteme mbH
Hardstrasse 9
D-78256 Steisslingen

satnms-support @ satservicegmbh.de

www.satnms.com
www.satservciegmbh.de
Tel +49 7738 97003
Fax +49 7738 97005

Table Of Contents

Table Of Contents 1
1 Introduction 3
2 Installation 5
2.1 Safety Instructions 5
2.2 Setting the IP Address 5
2.3 Connecting the Receiver 7
2.4 Configuring the Receiver 8
2.5 Mechanical installation 9
2.6 The sat-nms LBRX19 9
3 Operation 11
3.1 The Web-based User Interface 11
3.2 Displayed Readings 11
3.3 Operational Parameters 12
3.4 Installation Parameters 14
3.5 Frontpanel Operation 15
3.5.1 Display Mode 16
3.5.2 The Menu 17
3.5.3 Editing Numeric Parameters 18
3.5.4 Editing Multiple Choice Parameters 18
3.5.5 Manual Step Tuning 18
3.5.6 Fault Display 18
4 Remote Control 19
4.1 General command syntax 20
4.2 The TCP/IP remote control interface 20
4.3 The RS232 remote control interface 21
4.4 Parameter list 21
4.5 One line read via TCP/IP 23
4.6 UDP level distribution 23
4.7 Novella protocol emulation 24
5 Theory of Operation 26
5.1 Receiver Design 26
5.2 Processing of Measured Values 27
5.3 C/N Measurement 28
5.4 Frequency Tracking 29
5.5 Signal search 30
6 Specifications 32

1 Introduction

The ***sat-nms*** L-band beacon receiver manufactured by SatService GmbH is a measurement tool which measures the RF input level and provides this information as output signal for control systems. The main application of this receiver is in antenna tracking systems where the receiver provides the tracking signal level to the antenna step-track controller. Other applications can be pilot measurement and control loops like uplink power control.

The beacon RX receives a satellite beacon signal which is down-converted to L-Band by a PLL stabilized Low Noise Converter (LNC) at its L-band interface input. The beacon RX does not demodulate any satellite because the satellite signals are sometimes CW signals but also very often modulated in FM or BPSK form. Due to this fact the best implementation is a non-coherent receiver which measures the input level in a user selectable defined bandwidth and provides this as a dB-linear and calibrated analogue output voltage and digital information.

The level output is provided by three different and parallel available interface types: a HTTP Web Interface via an internal Web Server, a RS232 interface or the analog voltage output. The ***sat-nms*** beacon receiver is controlled remotely by a monitoring and control application through the TCP/IP interface. All communication with the power sensor is made with HTTP get requests. The beacon receiver implements the 'Hypertext Transfer Protocol' (HTTP, RFC-1945) both, for the user interface and for the M&C interface.

This document is the user manual provided with the ***sat-nms*** LBRX beacon receiver. It contains all necessary information how to install, setup and operate the receiver. The user manual is available as a printed document and for on-line reading on the beacon receiver itself as well.

Version 2.0 / 2011-11-10

The paragraphs below give a short overview to the contents of the documentation. A subset of this documentation is stored on the device itself, the complete documentation is available on the ***sat-nms*** documentation CD and at www.satnms.com.

- Installation: The installation chapter guides through the installation and setup of the LBRX beacon receiver. It describes the mechanical concept of the receiver box and the assignment of the receiver's connectors. Finally you learn in this chapter how to set the receiver's IP address, which is a essential precondition to operate the receiver by means of a web browser. This section is available in the printed version only.

- Operation: The ***sat-nms*** LBRX beacon receiver is operated using a standard web browser like the Internet-Explorer on MS Windows based computers. The user interface design is straight forward and clearly structured. Operating the receiver is mostly self-explanatory. Nevertheless, the 'Operation' chapter outlines the map of web pages which make up the LBRX user interface and elaborately describes the meaning of each alterable parameter.

- Remote Control: The LBRX beacon receiver provides a versatile remote control interface. A monitoring & control software may fully operate the receiver either through a TCP/IP network connection or through the RS232 interface of the receiver. This chapter describes the communication protocol used for remote control and lists all parameters accessible through the remote interface.

- Theory of Operation: This chapter gives a short overview how the receiver works. This not only includes a description of the receiver's electronic concept and the methods of temperature or frequency response compensation implemented in it. It also describes the the algorithms which implement the 'frequency tracking' and 'noise measurement' functions of this device. Knowing about the theory regarding this functions helps to find the best parameter settings for a given application.

- Specifications: At the end of the document, the specifications applicable to the ***sat-nms*** LBRX beacon receiver are summarized in this chapter.

Support and Assistance

If you need any assistance regarding our LBRX beacon receiver, don't hesitate to contact us. We would be pleased to help you by answering your questions.

SatService GmbH
Hardstrasse 9
78256 Steisslingen
- Germany -

phone +49 7738 9700-3 or -4
fax +49 7738 97005
www.satnms.com
satnms-support @ satservicegmbh.de

2 Installation

This chapter describes how to install the ***sat-nms*** LBRX beacon receiver. You find a guide how to connect, configure and mechanically mount the receiver below.

Before you start, please first read the Safety Instructions chapter below. It contains some important recommendations to prevent damage from the receiver.

Then, we strongly recommend to do a first setup of the receiver on a lab desk before installing it at it's final location. This is mainly for two reasons:

1. To setup the receiver's IP parameters, the PC used for configuring and the receiver must either be connected to the same Ethernet hub or must be connected directly with a crossover cable. The initialization program does not work through routers intelligent network switches.
2. The receiver may be configured to inject a 14/18V power supply voltage at it's RF input. If you plan to connect the receiver to a signal source which is not able to accept this D/C voltage, you must ensure that the voltage is switched off before you connect the receiver to that signal source.

Hence, the typical sequence of tasks when putting an ***sat-nms*** LBRX beacon receiver into operation is as follows:

1. Read the chapter Safety Instructions
2. Set the receiver's IP address
3. Check the LNB voltage setting
4. Mechanically mount the receiver
5. Connect the receiver to it's signal source, the power supply and the Ethernet network.

In chapter '2.6 The ***sat-nms*** LBRX19' you find some additional information about the installation of the 19" mountable variant of the ***sat-nms*** beacon receiver.

2.1 Safety Instructions

Failure to observe all Warnings and Cautions may result in personnel injury and/or equipment damage not covered by the warranty.

- Follow standard Electrostatic Discharge (ESD) procedures when handling an Power Sensor Unit.
- Select and apply the appropriate 24V D/C voltage according to the data sheet and documentation **before** connecting power.
- Before you connect the L-Band Beacon Receiver to an L-Band distributor or LNC , please make sure that the unit to which you connect can handle 18V D/C voltage on its RF L-Band output. Some L-Band IF distribution equipment does not have D/C blocks included and the unit could be damaged. If you are not sure how the interfacing equipment will behave, **switch off the LNC supply voltage** in the Setup menu before you connect a cable to the L-Band input of the beacon receiver.
- The L-Band Beacon Receiver can be damaged if the total RF input power is higher than +10dBm specified maximum value. Do not connect the RF input of the L-band Beacon Receiver to interfaces where the total output power is higher than the specified value of the data sheet or indicated on the Receiver.
- In case of a failure do not open the L-Band Beacon Receiver, you will loose warranty, call SatService GmbH for an RMA number.
- Observe normal safety precautions when operating, servicing, and troubleshooting this equipment.
- Take standard safety precautions with hand and/or power tools.
- When connecting the receiver's fault relay circuits, observe the maximum ratings: 120V D/C, 100mA. The fault circuits are Photo MOS semiconductor relays which will immediately damaged when connected to higher voltages than specified.

2.2 Setting the IP Address

Before you can operate the beacon receiver, you need to set the receiver's IP address. There is a special configuration program on the documentation CD shipping with the receiver for this purpose. We recommend to configure the receiver's TCP/IP settings before you install the receiver at it's final place. To configure the receiver, the following equipment is required:

- The ***sat-nms*** LBRX beacon receiver itself
- A 24V D/C power supply
- A Computer running a Microsoft Windows operating system equipped with CD-ROM drive and Ethernet network card.
- A CAT5 crossover network cable or a Ethernet hub and standard network cables to connect the beacon receiver and the computer.
- The CD-ROM shipping with the ***sat-nms*** receiver.

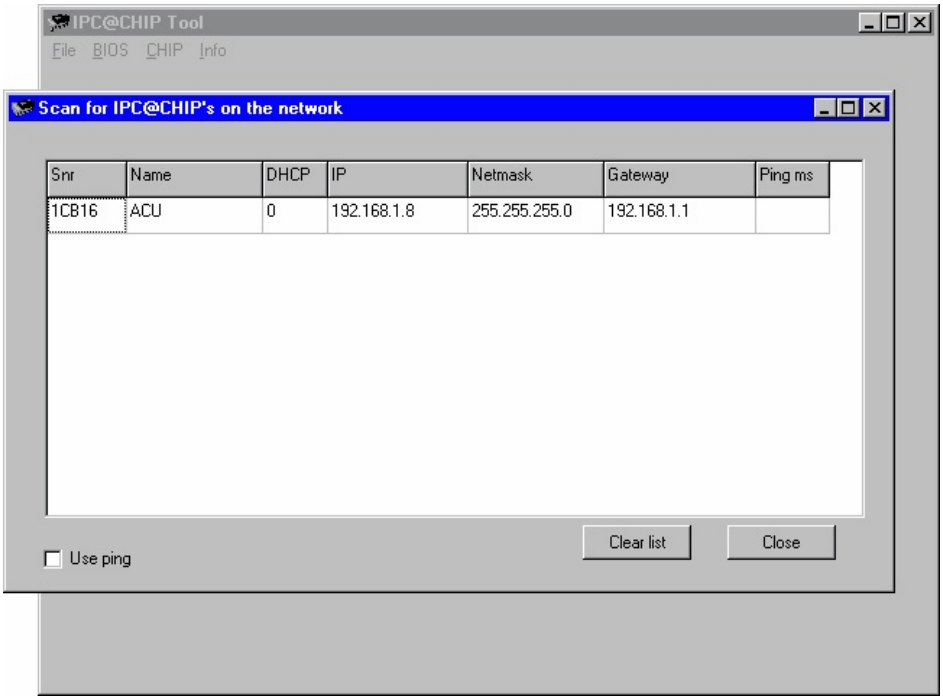
Setting the receivers IP parameters now is easily done within a few minutes.

1. First install a network cable between the receiver and your computer. If you have a crossover cable available, this is very easy: simply put the cable into the network connectors of computer and beacon receiver. Without a crossover cable, you need to connect both, the computer and the beacon receiver to the same network hub using two standard network cables. It is essential, that the computer and the receiver are connected to the same network segment, the configuration program is not able to find the beacon receiver through routers or network switches.

2. Now power on your computer and connect the beacon receiver to the 24V D/C supply.

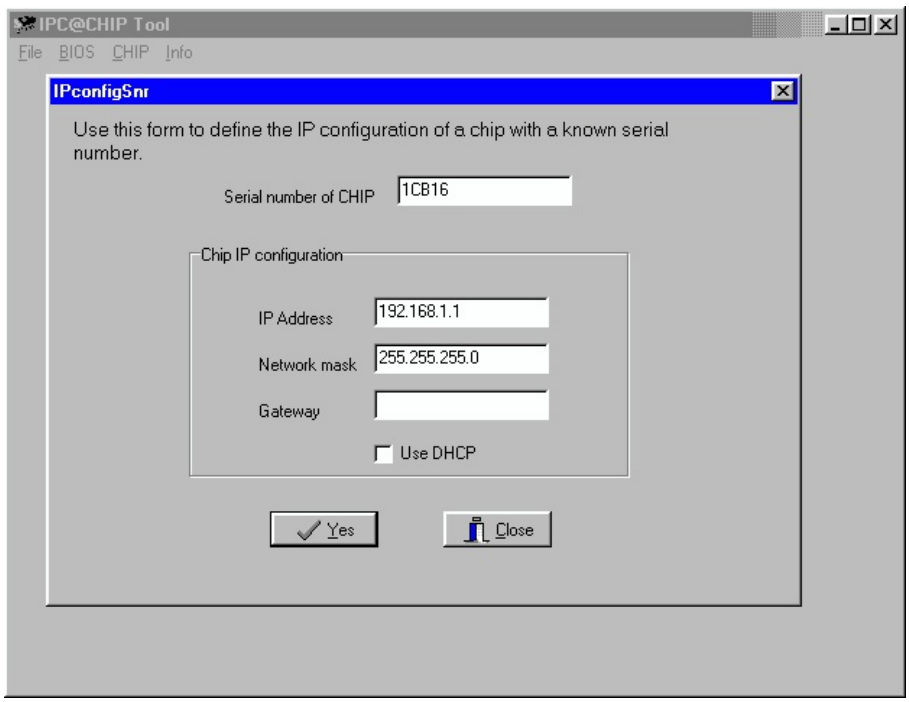
3. Insert the CD-ROM into the computer's drive and inspect it's contents through the 'My Computer' icon on your desktop. Double-click to the 'ChipTool.exe' program in the 'ChipTool' directory.

4. When the ChipTool program is running, type CTRL+F to make the program search the beacon receiver. The program shows a list containing at least one entry describing the actual network parameters of the receiver.



5. The serial number shown in the first column of the list, must match the serial number printed on the receiver's enclosure. If the list stays empty, the beacon receiver is not connected properly. If there are more entries in the list, the configuration program has found other devices in this network segment which use the same technology.

6. Now type CTRL+I to open the IP configuration window of the program. In this form enter the receiver's serial number, it's new IP address and network mask. If the receiver later shall be operated through a router, enter the address of the router on the gateway field, otherwise leave this field blanc. Be sure, that the 'DHCP' mark is unchecked. Finally click to the 'Yes' button to set the new parameters at the beacon receiver



Now the IP configuration of the receiver is completed. You may finally want to test if the beacon receiver is reachable now. Start your web browser and type the receiver's IP address into the URL field of the browser. The beacon receiver should reply with it's main page, provided that the receiver and your computer are configured for the same subnet.

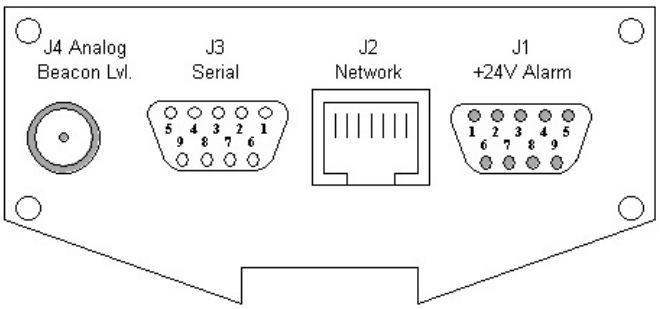
2.3 Connecting the Receiver

The connectors of the receiver are placed on both sides. One side contains the D/C and Data connectors, the other side the RF connectors. When you connect the receiver, please consider the following:

- The fault relays at J1 are Photo MOS solid state circuits. In fault state or while the unit is powered off they are in hi-Z state (several MOhms). A resistance below 25 Ohms indicates that the function is OK.
- J2 is the Ethernet 10Base-T / RJ45 connector. Use a standard network cable to connect the receiver to an Ethernet hub. If you want to connect your computer and the receiver directly without using a hub, you need a crossover cable for this with swapped RX/TX lines.
- J3 is a standard 9-pin RS232 (DCE) connector. You may use a direct 9-pin cable to connect a PC to the beacon receiver. The RTS/CTS and the DTR/DSR lines are bridged in the receiver to simulate hardware handshaking. They need however not to be connected, if you want to use a 3 wire cable.
- The RF input J5 may be configured to power a LNB. If you intend to connect the receiver to a signal source which may not be able to withstand the LNB supply voltage, be sure to switch off the LNB supply at the receiver by means of the web based user interface before you connect the receiver input!

D/C and data connectors

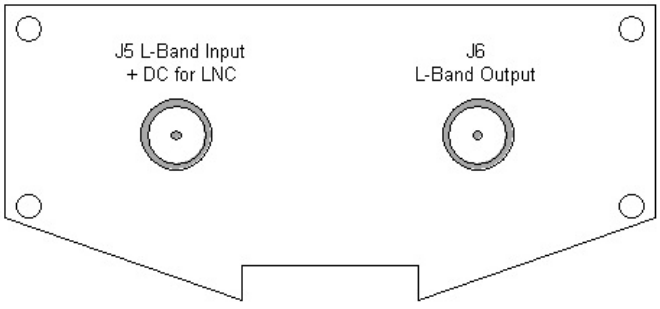
The D/C and data connectors of the receiver all are located at one of the side panels of the enclosure. The figures below illustrate location of connectors and the pin out.



J1	pin no.	**Power supply and alarm contacts (SUB-D 9P pin)**	**J3**	pin no.	**RS232 serial interface, DCE, (SUB-D 9P socket)**
	1	Power supply +24V		1	not connected
	2	Power supply +24V		2	TxD (output)
	3	not connected		3	RxD (input)
	4	GND		4	internally bridged to pin 6
	5	GND		5	GND
	6	Fault relay (120V D/C, 100mA max.)		6	internally bridged to pin 4
	7	Fault relay		7	internally bridged to pin 8
	8	Level/Frequency track fault relay (120V D/C, 100mA max.)		8	internally bridged to pin 7
	9	Level/Frequency track fault relay		9	not connected
J2		**Ethernet 10Base-T, (RJ45)**	**J4**		**Beacon level 0..10V (SMA female)**

RF connectors

The other side panel of the enclosure contains the RF connectors. These are the RF input which may be configured to inject a LNB supply voltage of 14 or 18 Volts and the RF output which loops through the input signal.



J5	**RF Input (SMA female)**	**J6**	**RF Output (SMA female)**

2.4 Configuring the Receiver

This chapter gives a short overview about some configuration parameters you want to set after you have installed the ***sat-nms*** LBRX beacon receiver. A complete reference of all available setup parameters is given in chapter 3.4 Installation Parameters.

LNB LO Frequencies

The receiver lets you enter the receiver frequency in terms of the RF frequency at the antenna. You have to configure the LNB conversion frequency at the receiver's setup page. The receiver is prepared to manage

separate LO frequencies for a lower and a upper band LNB. The setup parameter you have to configure are:

- High band LO frequency
- Low band LO frequency
- Band edge

If your antenna provides only one single conversion frequency, set this value for both LO frequency parameters and set the band edge to zero. The receiver also supports applications where the LO frequency is above RF receive frequency. In this case, enter the LO frequencies as negative values.

LNB Supply Voltage

The receiver is able to supply a LNB through the L-band cable. Set the 'LNB voltage' parameter to the appropriate value. The special value 'AUTO' enables the LNB supply voltage and switches between 14V and 18V following the receive polarization you set.

LNB Frequency Band Selection

For antennas switching between frequency bands with a 22kHz tone controlled switch the receiver is able to generate the 22kHz tone either permanently or automatically depending on the receive frequency. Set the '22kHz tone' parameter to one of the settings OFF, ON or AUTO.

Relay 2 Function

One of the relay outputs available at the J1 connector may be programmed to act either as a level alarm (the circuit opens if the receive level falls below a adjustable level) or as a frequency tracking alarm. The latter indicates that the frequency tracking function does not recognize a trackable signal. This is much like the 'lock alarm' of a coherent receiver.

2.5 Mechanical installation

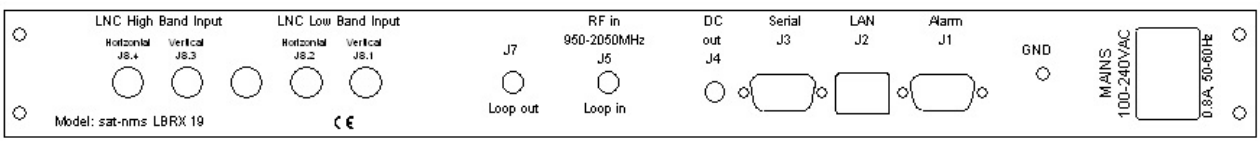
The receiver enclosure is DIN rail mountable. Hence simply snap the receiver on to the rail to fix it. For plain wall mount, fix a 270 mm piece of DIN rail at the wall with at least two screws and lock the receiver on this.

When planning the mechanical installation of the receiver, please consider that the connectors are placed at the front sides of the enclosure. Depending on the flexibility of the cables you are going to use, you will require about 10 centimeters space for cabling on both sides of the receiver.

2.6 The *sat-nms* LBRX19

Connecting the *sat-nms* LBRX19

The ***sat-nms*** LBRX19 provides an integrated multiswitch, which allows the beacon receiver via its input frequency and polarization parameters the selection of the corresponding LNC. The input connectors are named J8.1 ... J8.4. The other connectors J1...J5 are labeled and used the same way as in the DIN-rail mountable LBRX.



rear view of the ***sat-nms*** LBRX19

Using the *sat-nms* LBRX19 without the integrated Multiswitch

For using the ***sat-nms*** LBRX19 without the integrated Multiswitch, you feed the beacon Signal via an SMA

connector to J5 (Loop In). The LBRX19 provides in this case the possibility to control an external switch via 14/18V Signal and 22 kHz Tone on/off or just to supply voltage to an LNC.

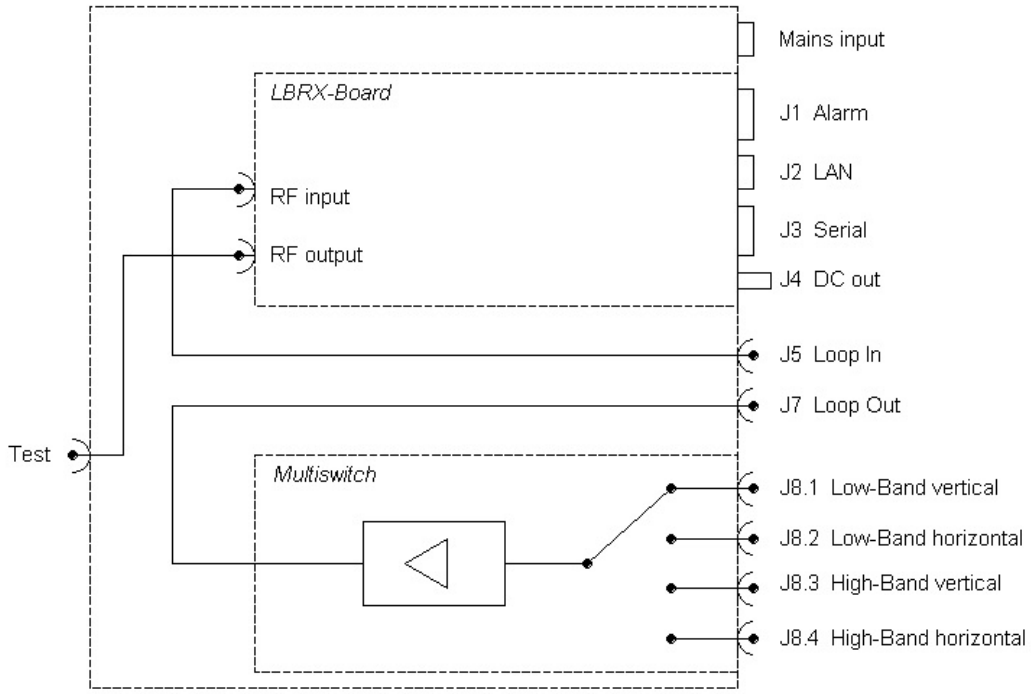
Using the integrated Multiswitch

If you like to use the integrated Multiswitch, connect the LNCs with F-type connectors as follows:

LNC	*connector*
Low Band (11GHz) vertical	J8.1
Low Band horizontal	J8.2
High Band (12GHz) vertical	J8.3
High Band horizontal	J8.3

J5 (Loop In) and J7 (Loop Out) have to be connected via the corresponding SMA-SMA semi-rigid cable. If you like the ***sat-nms*** LBRX19 to switch automatically to the LNC, the parameters "LNB voltage" and "22kHz Tone" on the "Settings" page have to be set to "AUTO". The parameter "High band LO frequency", "Low band LO frequency" and "Band edge" have to be configured as well to allow the LBRX19 the automatic switching between the different LNCs. For a standard LNC we recommend the following settings:

Parameter name	*Setting*
LNB voltage	AUTO
22kHz Tone	AUTO
High band LO frequency	9750 MHz
Low band LO frequency	10600 MHz
Band edge	11800 MHz



Block diagram

3 Operation

The ***sat-nms*** LBRX beacon receiver is designed to be controlled over a network link using a standard web browser. This means in practice, that the user interface to the receiver appears in your browser window after you type in the receiver's IP address in the address field of the browser program.

Operating the receiver is mostly self-explanatory.

3.1 The Web-based User Interface

After having connected the LBRX to a power supply and set the receivers IP address, you can access the receiver's user interface. To do this, start your favorite web browser program (Internet Explorer, Netscape Navigator, Opera or what else Program you prefer). At the address field, where you normally enter the URL of a web page you want to see, type in the IP address of the ***sat-nms*** LBRX receiver you want to control.

The receiver shows a web page consisting of a navigation bar at the left side of the browser window and the actual readings of the receiver in the main part of the window. The readings automatically refresh once a second.

The navigation bar at the left contains five buttons which build the receiver's main menu:

Readings This button switches back to the receivers main page you already see when you connect to the receiver. This page displays the actual readings of the receiver.

Settings By clicking to this button you switch to the 'Settings' page where you can view and change the common operational settings of the receiver like frequency or bandwidth.

Setup This button switches to the 'Setup' page which lets you inspect or change less common parameters which usually are set only once to adapt the receiver to it's working environment.

Info After a mouse click to this button, the beacon receiver shows a table with information like the serial number of the device or the revision ID and compilation date of the software.

Help Clicking to this button shows the on-line version of this user manual

3.2 Displayed Readings

The 'Readings' page is the main page of the beacon receiver which shows the actual measurement values and some important settings. Parameter settings reported here, are for information only. To change a setting switch to the Settings page. The 'Readings' page automatically refreshes once a second. The table below describes the information shown by this page:

Parameter Name	*Description*
Input level	This is the actual signal level at the receiver's L-band input. When operating on one of the C/N measurement modes, this field shows the actual C/N or C/N0.
Frequency	This is the frequency the receiver is tuned to. Depending on the LO frequency settings made on the Setup page, the frequency value either shows the true RF frequency received by the antenna or the L-band frequency at the receiver's input.
Frequency tracking offset	This value shows the actual frequency tracking offset, the receiver applies to the receive frequency. The true receive frequency used by the receiver is the nominal frequency from the field above with the offset from this field added. A frequency offset displayed here is added to the nominal frequency even if the frequency tracking is switched off. Setting a new nominal frequency value resets the offset to zero.
Frequency tracking	Shows if the frequency tracking function is actually enabled.

Attenuation	Shows the actual input attenuator setting.
Measurement bandwidth	Shows the measurement bandwidth actually used by the receiver.
Post detector filter	This is the low pass filter applied to the measured level before the value gets displayed or sent to the analog output of the receiver. The filter corresponds to the video filter of a spectrum analyzer.
Noise level	If the receiver operates in one of the C/N measurement modes, this value shows the noise level the receiver measured with the recent measurement.
Analog output voltage	This value shows the voltage the receiver actually outputs at it's analog output port. Please note that the reading shown here is not calibrated match the true output voltage exactly.
Temperature	The temperature shown is the temperature measured on beacon receiver printed circuit board. The temperature at this place normally is about 20C above the environment temperature, hence temperature readings at 65C are not unusual.
Receive Level Alarm	If the receive level falls below the 'Alarm threshold' set on the Settings page, the receiver states FAULT here.
Frequency Tracking Alarm	If the frequency tracking function is enabled and the tracking algorithm fails to optimize the receive frequency setting, the receiver reports a FAULT here.
Synthesizer Lock Alarm	If one of the PLL synthesizers in the receiver does not lock, a FAULT is reported here. This happens if you tune the frequency out of it's valid range.
D/C Supply Alarm	The receiver monitors it's internal supply voltages. if one of them is out of range, a FAULT is stated here.

3.3 Operational Parameters

The page 'Settings' contains the receiver's operational parameters. Operational parameters are those which are assumed to be changed more frequently than the installation parameters on the Setup page.

The page displays a table with the parameters actually set. Each parameter value is a hyper-link to a separate page which lets you change this parameter. This parameter change page shows the actual parameter setting either in an entry field or in a drop down box. You may change the parameter to the desired value and then click to the 'Submit' button to pass the changed value to the receiver. The receiver automatically returns to the settings page when the parameter has been changed. To cancel a parameter modification you already started, either use the 'Back' button of you web browser or click to the 'Settings' button on navigation bar. Both returns to the settings page without changing the parameter you edited.

The table below lists the settings provided by this page.

Parameter Name	*Description*
RF receive frequency	This is the receiver's nominal receive frequency. Depending on the LO frequency settings made on the Setup page, the frequency value either is expressed as the RF receiver frequency or the L-band frequency at the receiver's input. If the '22 kHz Tone' setup parameter is configured as 'AUTO', changing the frequency also may switch the 22kHz modulation on the LNB power supply on or off.
Polarization	If on the Setup page the 'LNB voltage' parameter is set to 'AUTO', the receive polarization may be set with this parameter by changing the LNB Voltage.
Attenuation	The receiver provides a switchable input attenuator which lets you adjust the input level in 10 dB steps. This is specially useful with large Antennas pointing to a satellite which generate a high flux density. With the attenuator you may adjust the input level in order to avoid saturation effects in the receiver. All input attenuator steps are calibrated, the attenuation values are taken into account for the displayed receive level. Available

	attenuator settings are 0, 10, 20 and 30 dB.
Measurement Bandwidth	The receiver provides four different measurement bandwidth filters (6, 12, 30 and 100 kHz). The 30 kHz filter is suitable for majority of cases.
Post detector filter	The receiver's software applies a low pass filter to the measured level values. This is much like the video filter at a spectrum analyzer. Available bandwidth settings for this filter are 0.1 to 5 Hz in 1/2/5 steps. Lower bandwidth settings make the reading more stable, reduce the fluctuation. Please keep in mind, it will take a noticeable time until the level reading settles after an input level change with a very low bandwidth setting.
Spectrum Compensation	With this parameter set to 'OFF', the receiver's level reading is calibrated for a C/W signal. By selecting a modulation type for this parameter, the level display gets compensated for the selected modulation type.
Alarm Threshold	With this parameter you set the level threshold. If the measured level falls below this value, the receiver states a receive level fault. To disable the level alarm, set the threshold to a very low value, e.g. -120 dBm. Please note, that the threshold value refers to the signal level, even if the receiver operates in a C/N measurement mode.
Signal search enable	Setting this parameter to ON enables the automatic signal search function. With signal search enabled, the receiver searches the signal within the frequency tracking range when the signal ist lost. Chapter 5.5 Signal search describes this function more detailed. 'SEARCH NOW' starts a search scan immediately, regardles of the enable setting.
Signal search delay	This parameter defines the time, the receiver waits after the signal was lost until a search scan ist started. The valid range of this parameter is 0 .. 600 seconds.
Frequency Tracking	This parameter switches the the frequency tracking facility of the receiver ON or OFF. A description of the frequency tracking facility is given in chapter 5.4 Frequency Tracking.
Frequency Tracking Interval	This parameter sets the interval on which the frequency tracking procedure operates. The value is in seconds. Recommended settings are 15 seconds to tune the receiver quickly to a frequency you do not know precisely. For normal operation a frequency tracking interval of one hour (3600 secs) is recommended.
Frequency Tracking width	With this setting you limit the frequency offset the frequency tracking procedure may apply to the nominal frequency. The frequency tracking never tunes the receiver to a frequency outside the nominal frequency +/- this value, a frequency track fault is generated if the tracked frequency reaches the limit.
C/N Noise measurement	With this parameter you select if the receiver shall perform a plain input level measurement or a C/N measurement. A description of the C/N measurement function of the receiver is given in chapter 5.3 C/N Measurement. You may select one of the following measurement modes: **OFF** The receiver performs a plain level measurement. The Readings page shows the input level in dBm. **C/N** The receiver measures the signal / noise ratio. The Readings page shows the C/N in dB. **C/N0** Like the C/N mode, but the receiver normalizes the C/N value to 1 Hz measurement bandwidth. The Readings page shows the C/N0 in dBHz.
Noise Measurement Frequency	With this parameter you specify the frequency at which the receiver shall measure the noise level at a certain interval. Like with the receive frequency, the LO frequency settings made at the Setup page are taken into account also for this frequency value. To get reasonable results with a C/N measurement, you should consider the following: 1. The receiver does not change the LNB frequency band setting when it switches from the level measurement to the noise measurement. The LNB probably would change it's gain in this case. The noise measurement frequency hence must be in the

	same frequency band as the receive frequency. 2. Measuring the noise level at the band edge may falsify the result due to the LNB's band filter. The measured noise level may be too low in this case. 3. You should verify with a spectrum analyzer, that no signal disturbs the noise measurement at the selected frequency.
Noise Measurement Interval	This parameter defines the interval at which the receiver inserts noise measurements in the C/N modes. The time is specified in seconds. 3600 secs being one hour is a suitable setting in most cases.

3.4 Installation Parameters

The page 'Setup' contains the receiver's installation parameters. Installation parameters are those which are assumed to be changed less frequently than the operational parameters on the Settings page.

The page displays a table with the parameters actually set. Each parameter value is a hyper-link to a separate page which lets you change this parameter. This parameter change page shows the actual parameter setting either in an entry field or in a drop down box. You may change the parameter to the desired value and then click to the 'Submit' button to pass the changed value to the receiver. The receiver automatically returns to the setup page when the parameter has been changed. To cancel a parameter modification you already started, either use the 'Back' button of you web browser or click to the 'Setup' button on navigation bar. Both returns to the setup page without changing the parameter you edited.

The table below lists the settings provided by this page.

Parameter Name	*Description*
LNB voltage	This parameter controls the LNB supply voltage provided by the receiver at it's input connector. The following settings are available: **OFF** The D/C voltage is completely switched off. **14V** The LNB supply voltage is 14V **18V** The LNB supply voltage is 18V **AUTO** The LNB supply voltage is switched on, the voltage depends on the 'Polarization' parameter available on the Settings page. The voltage is 14V for vertical polarization, 18V for horizontal polarization.
22KHz Tone	This parameter controls the presence of a 22 kHz tone on the LNB supply voltage. The following settings are available: **OFF** The 22 kHz tone is switched OFF. **ON** The 22 kHz tone is switched ON. **AUTO** The receiver automatically enables the 22 kHz tone depending on the receive frequency set. The tone is switched OFF for frequencies below the band edge, switched ON for frequencies above the band edge. The band edge is set with the 'Band edge' parameter below.
High band LO frequency	This parameter sets the conversion (LO) frequency frequency for the upper frequency band LNC. Common values for this frequency are 11300 MHz or 10600 MHz for consumer antennas. Set this value to zero if you intend to set the receive frequency in terms of L-band frequency. Normally the receiver assumes, that the LO is *below* the RF receive frequency as this is common for Ku-band LNCs. If the LO is *above* above the receive frequency (e.g. for a C-Band application) enter the LO frequency as a *negative* value.
Low band LO	This parameter sets the conversion (LO) frequency frequency for the lower frequency

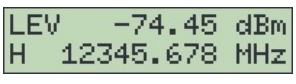
frequency	band LNC. Common values for this frequency are 10000 MHz or 9750 MHz for consumer antennas. Set this value to zero if you intend to set the receive frequency in terms of L-band frequency. If the LO is *above* above the receive frequency (e.g. for a C-Band application) enter the LO frequency as a *negative* value.
Band edge	This parameter defines the frequency threshold where to switch between the frequency bands.
Analog output scale	This parameter defines the slope of the receiver's voltage output in V/dB. The output voltage has a range of 0 .. 10 V. Setting this parameter to 0.25V/dB lets the analog output cover a dynamic range of 40 dB.
Analog output offset	This parameter defines, which input level gives 0V output.
UDP destination address	This parameter defines the IP address to which the beacon receiver sends UDP datagrams with the actual measurement value. Enter the destination IP address in 'dotted quad' notation or the keyword 'none' to prevent the beacon receiver from sending UDP datagrams. Chapter 4.6 UDP level distribution explains this communication feature more detailed.
Communication address	This parameter defines the communication address to be used with the serial interface. You may select an address 'A' .. 'G' for the packet mode communication protocol or 'NONE' to switch the communication mode to a plain text protocol.
Novella emulation	This parameter sets the communication protocol the receiver provides with the serial RS232 interface. 'OFF' enables the standard ***sat-nms*** communication protocol as described in chapter 4 Remote Control. Setting the parameter to 'ON' makes the receiver behave like a Novella beacon receiver. The Novella protocol emulation is described in chapter 4.7 Novella protocol emulation .
Relay 2 function	This parameter defnes if the beacon receiver shall signal a beacon level fault ('LEVEL') or a frequency track fault ('FTRACK') at the relay 2 output.
Note	You may enter a note / comment here which is displayed by the beacon receiver as the heading of the 'Readings' page.
Display refresh	With this parameter you control the display refresh rate of the standard reading / status web-page. The default setting is 1 second. You may slow down the page refresh down to once every 30 second with this setting. Setting the refresh rate to 0 disables the page refresh completely, you may use your borswer's 'reload' button to trigger a page refresh manually in this case.
User password	Here you can define the password for the 'user' login. Default password is 'user'. When you are logged in as 'user' you can control the operating parameters at the 'Settings' page and the fine tuning buttons at the navigation bar. You can't modify the setup parameters while logged in as 'user'.
Admin password	Here you can define the password for the 'admin' login. Default password is 'admin'. When you are logged in as "admin" you have full access to all parameters of the receiver.

3.5 Frontpanel Operation

The rack mountable version of the ***sat-nms*** beacon receiver provides a LCD and a small keyboard at the front panel for operating the device locally.

Display

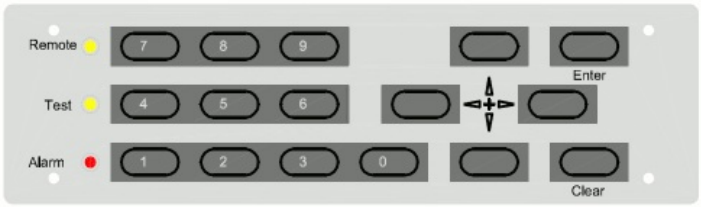
The 2-line display normally shows the actual measurement value and some common parameters. During menu operation it is used to view and edit each individual parameter of the beacon receiver.



LEDs

Three LEDs at the front panel signal the summary state of the beacon receiver.

- The 'Remote' LED is on while the receiver is controlled from a remote computer via network or serial interface. There is no elusive remote or local lockout mode with the ***sat-nms*** beacon receiver. Local operation of the receiver is still possible while the device is accessed remotely. The 'Remote' LED is just an information, that someone from remote talks to the device and a local change of parameters may interfere with this.
- The second LED labeled 'Test' shows the 'latched fault' condition. The LED lites on if a Fault/Alarm occurs and stays on until the operator clears the latched fault (see 3.5.6 Fault Display for details).
- The 'Alarm' LED is on while the receiver is in alarm state. This is the same condition which controls the fault relay output.



Keys

The front panel keyboard provides beside the numeric keys four arrow keys and two keys named ENTER and CLEAR. The general meaning of the keys remains constant through all levels of the menu:

ENTER — The ENTER key descends in the menu tree, accepts and stores changed values.

CLEAR — The CLEAR key leaves to higher menu levels, abandons changes when editing parameters. It also resets the alarm buzzer when in display mode.

The arrow keys navigate in the menu, in some cases they also increment / decrement values.

0 .. 9 The number keys are to enter numeric parameters.

3.5.1 Display Mode

The display mode shows the actual reading and some additional information in the display. This is the default mode, the beacon receiver enters it automatically after power on. Depending on the selected measurement mode, the default display looks like this:

LEV -74.45 dBm H 12345.678 MHz	C/N 12.45 dB H 12345.678 MHz	C/N0 5.45 dBHz H 12345.678 MHz
level measurement	*C/N measurement*	*C/N0 measurement*

The upper display line shows the actual measurement, the lower line shows the receive polarization and frequency (the polarization is only shown if the LNB voltage is configured for polarization selection).

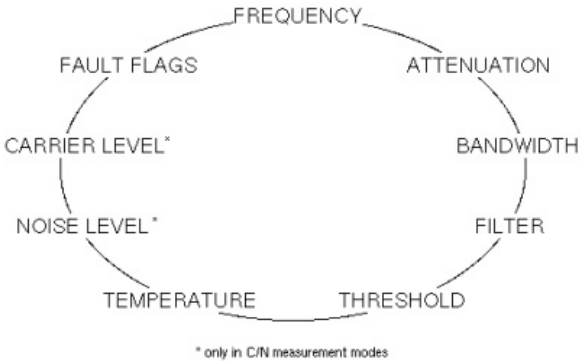
While the receiver is not in a regular state, the lower line of the display shows a message indicating this. The ordinary contents of the display and the message are shown alternately, the message 'blinks' on the display. The following messages may be displayed:

* SUPPLY FAULT *	There is a problem with the power supply of the receiver. (hardware fault)
* SYNTH FAULT *	One of the receiver's frequency synthesizers does not lock. (hardware fault)
<< SEARCHING >>	The receiver had lost the signal, is actually searching it.
* THRESH FAULT *	The measurement value is below the threshold defined in the settings.
<< TRACKING >>	The receiver actually performs a frequency tracking. The measurement

	value appears frozen during this procedure.
* FTRACK FAULT *	The receiver failed to optimize the receive frequency, probably due to a bad C/N.

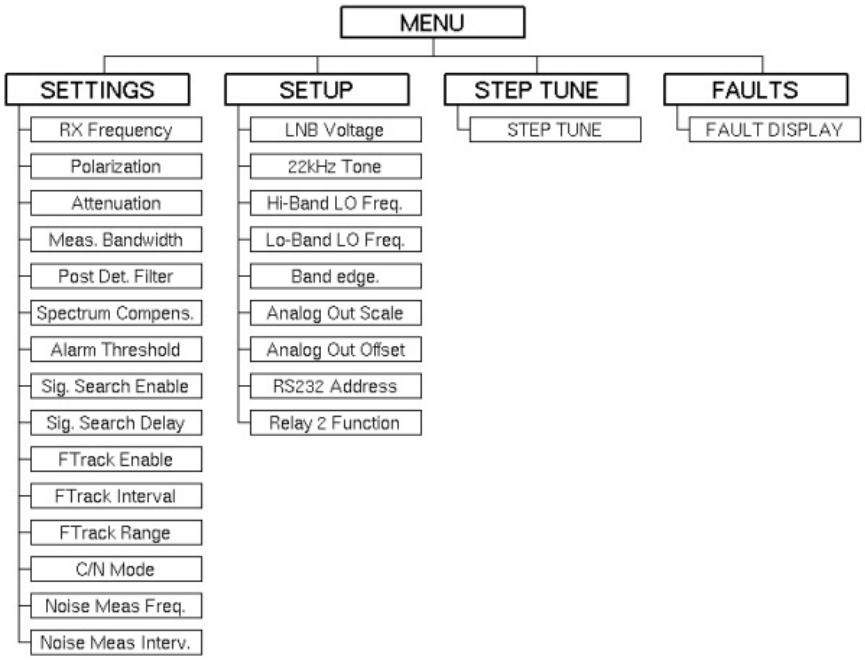
If more then one of the above conditions occur, only that one with the highest precedence is shown. This means for example that the 'SEARCHING' state precedes over the 'THRESH FAULT' which caused the receiver to search the signal. For a detailed fault report, see chapter 3.5.6 Fault Display

Instead of showing the receive frequency, the lower display line may be set to display more parameters. Use the arrow keys to step through the available display variants, the 'CLEAR' key resets the display to show the receive frequency.



3.5.2 The Menu

The menu mode lets you view and change the receiver's settings. From the display mode, you enter the menu by pressing the ENTER key. To leave the menu, repeatedly press the CLEAR key until the display screen appears again. If there are no keystrokes for 2 minutes, the receiver automatically leaves the menu and returns to display mode. The menu structure is shown in the diagram below:



The 'SETTINGS' sub menu lets you view and modify the operational parameters of the receiver. The 'SETUP' sub menu contains a number of parameters which usually only need to be changed during the beacon receiver installation. For further information about the receiver parameters see the chapters 3.3 Operational Parameters and 3.4 Installation Parameters of this manual.

To navigate in the menu, use the ◄ ► to select a sub menu, then press ENTER to descend in the selected menu branch. Within the 'SETTINGS' and 'SETUP' sub menus use the ▲ ▼ keys to select the desired parameter.

Pressing CLEAR one returns to the main menu level, pressing it twice returns to display mode.

3.5.3 Editing Numeric Parameters

To change a numeric parameter like the receive frequency, select this value from the 'SETTINGS' or 'SETUP' menu. The upper display line describes the parameter, the lower line shows it's value:

```
RX Frequency
   12345.678 MHz
```

To set a new value, press ENTER. This clears all figures from the value display and shows '>' at the first column to signal the editing mode. Using the number keys, you enter the new value. The digits fill the entry field from right to left, like with a pocket calculator. The ◄ key may be used to delete the last digit.

```
RX Frequency
>       .  1 MHz
```

```
RX Frequency
>  11145.333 MHz
```

To accept the edited value, press ENTER. This checks the entered value against it's limits and executes the parameter change. Pressing CLEAR twice (the first key press clears the display) leaves the editing mode without changing anything.

3.5.4 Editing Multiple Choice Parameters

To change a numeric parameter like the measurement bandwidth, select this value from the 'SETTINGS' or 'SETUP' menu. The upper display line describes the parameter, the lower line shows it's value:

```
Meas Bandwidth
         100 kHz
```

To set a new value, press ENTER. This changes to the editing mode, signalled by a '>' character in the first column. Use the ◄ ► keys to change the value.

```
Meas Bandwidth
>         12 kHz
```

To accept the changed value, press ENTER. Pressing CLEAR leaves the editing mode without changing the value.

3.5.5 Manual Step Tuning

The step tuning page lets you adjust the receive frequency with the arrow keys while watching the receive level.

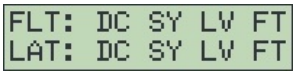
From the main menu, select 'STEP TUNE' and press ENTER to enter this mode. The display shows the receive level (live updated) and the actual receive frequency. The ▲ ▼ keys change the frequency in steps of 1 kHz, the ◄ ► keys perform 10 kHz steps.

```
LEV   -74.45 dBm
   12345.678 MHz
```

If you leave the step tune page by pressing CLEAR, the receiver reverts it's receive frequency to the value prior to the adjustment. To keep the adjusted value as the new receive frequency, press ENTER.

3.5.6 Fault Display

The fault display page lets you view the actual state of all fault flags and also the latches state of these flags.



From the main menu, select 'FAULTS' and press ENTER to see the faults display. The upper line shows the momentary active fault conditions, the lower line the latched faults. Active faults are represented by a 2-character memnotic, inactive faults by dashes.

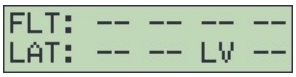
DC There is a problem with the power supply of the receiver. (hardware fault)

SY One of the receiver's frequency synthesizers does not lock. (hardware fault)

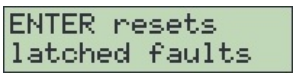
LV The measurement value is below the threshold defined in the settings.

FT The receiver failed to optimize the receive frequency, probably due to a bad C/N.

The example below shows a more practical example of a faults display page. It tells that actually everything is OK, but since the last reset of latched faults the beacon level at least once was below it's threshold.



When you leave the faults display page (CLEAR does this), the receiver asks whether to reset the latched faults. To acknowledge this, press ENTER. To leave the fault display without resetting the latched faults, press CLEAR a second time.



4 Remote Control

The ***sat-nms*** beacon receiver may be controlled remotely by a monitoring and control application either through the TCP/IP interface or through a serial RS232 interface. Both communication methods use the same commands and parameters, however, there are different frames around each message depending communication method used.

Controlling the device from the web interface, the TCP/IP remote control interface or via the serial interface is completely equal, commands may sent to any interface at any time, the receiver will use the parameter it receives last.

4.1 General command syntax

The beacon receiver knows a number of parameters, each identified by a parameter name. To set a certain parameter to a new value, a message:

name=value

has to be sent to the receiver. The receiver interprets this command, checks the range of *value*, sets the internal parameter and then answers:

name=value

The *value* in the reply is the value actually recognized by the beacon receiver. For instance, if the requested value was out of range, the replied (and internally used) value is limited to the applicable minimum or maximum.

To read a parameter from the receiver, instead of a new parameter value a question mark is sent:

name=?

The receiver replies the actual value in a complete message:

name=value

A complete list of the parameter the beacon receiver knows is shown later in this document in chapter Parameter list. Below, some common rules applying to the remote control message syntax are summarized.

- Parameter names always are of lower case letters, most of them are four characters long.
- Non-numeric parameter values always are written in upper case.
- Numeric (floating point) values may be specified with an arbitrary precision, however the device will reply only a fixed number of places. The receiver recognizes a decimal point ('.'), numbers must not contain any commas.
- There must not be any whitespace in front or after the '=' in a message.
- If the command/query is not of the form **name=value** or **name=?**, the receiver replies the message **? SYNTAX**.
- If the message syntax is OK, but contains an unknown parameter name is used, the reply is **? UNKNOWN**
- Numeric parameters are cut to the limits defined for this particular parameter.
- Misspelled choice values cause the receiver to set the first value of the choice list.
- Assigning a value to a read-only parameter will cause no fault, however the beacon receiver will overwrite this parameter immediately or some seconds later with the actual value.

4.2 The TCP/IP remote control interface

Controlling the beacon receiver through the network is done by means of HTTP GET requests. Setting parameter values or querying readings or settings, all is done by requesting HTTP documents from the receiver. The message *to* the receiver thereby is coded into the URL as a CGI form parameter. The receiver

replies a one line document of the MIME type 'text/plain'.

The document name for remote control is **/rmt**, hence (assuming the beacon receiver is listening to the IP address 10.0.0.1), requesting a document with the URL

http://10.0.0.1/rmt?levl=?

will let the receiver reply the actual beacon level in a one line text document:

levl=-52.31

This way all parameters may be queried or set, you may use your favorite web browser to try out the remote control of the receiver manually.

4.3 The RS232 remote control interface

Beside the network interface, the beacon receiver also provides an RS232 serial port which can be used to control the device remotely. Depending on the device address set, the receiver either runs framed protocol with start/stop characters and checksum or it provides a dumb terminal interface. The RS232 interface always operates at 9600 baud, no parity, 8 data bits, one stop bit.

If an address 'A' .. 'G' is selected, the receiver expects each message it receives to be packed into a frame as described below.

char #	*example*	*description*
1	{	start character, always '{'
2	A	device address (A..G)
3	l	first character of the message body
.	e	message body ...
.	v	..
.	l	..
.	=	..
n-1	?	last character of the message body
n	}	end character, always '}'
n+1	.	checksum

The checksum byte is calculated using an algorithm as implemented by the following formula:

$$sum = 32 + \left(\sum_{i=1}^{n} (byte[i] - 32) \right) \text{ modulo } 95$$

This protocol type is known as *MOD95-* or *Miteq protocol*. The receiver also packs it's reply in a protocol frame as described above. incomplete frames, checksum errors or address mismatches let the receiver ignore the message. The time between the characters of a message must be less than 5 seconds or the receiver will treat the message as incomplete.

If the beacon receiver is set to the device address 'NONE', it uses a simple line protocol instead of the framed protocol described above. Messages sent to the receiver have to be terminated with a carriage return character (ASCII 13), the receiver terminates replies with a CR/LF pair (ASCII 13/10). There is no echo for characters entered, hence this protocol easily may be used for computer based remote control.

4.4 Parameter list

The table below shows the complete list of M&C parameters the beacon receiver knows. For each

parameter the valid range and a short description is given.

name		*range*	*unit*	*description*
adcv	r/o	0 65535		Raw AD/C value
addr		A B C D E F G NONE		Communication address
aout	r/o	0.0 .. 10.0	V	Analog output voltage
attn		0 10 20 30	dB	Attenuation
bgih		OFF ON		Background activities (noise, frequency track) inhibit
c2n0	r/o	0 .. 99.9	dBHz	C/N0 ratio in 1Hz, only valid in C/N modes
cnmf		0 .. 40000.000	MHz	Noise measurement frequency
cnmi		1 .. 21600	sec	Noise measurement interval
cton	r/o	0 .. 99.9	dB	C/N ratio, only valid in C/N modes
daco		-200 .. 0	dB	Analog output offset
dacs		-5.0 .. 5.0	V/dB	Analog output scale
dflt	r/o	OK FAULT		D/C supply fault
drfr		0 .. 30	sec	Display refresh rate
edge		0 .. 40000.000	MHz	Band edge
fflt	r/o	OK FAULT		Frequency tracking fault
fltr		0.1 0.2 0.5 1 2 5		Post detector filter
fofs	r/o	-1000 .. 1000	kHz	Frequency tracking offset
freq		depends on LO settings	MHz	RF receive frequency
ftri		1 .. 21600	sec	Frequency tracking interval
ftrk		OFF ON		Frequency tracking mode
ftrp	r/o	0 1		Frequency tracking in progress
ftrw		10 .. 1000	kHz	Frequency tracking width
lbfr	r/o	950 .. 2050	MHz	L-Band receive frequency
levl	r/o	-999.99 .. 0	dBm	Beacon level
ln22		OFF ON AUTO		22kHz Tone
lnbv		OFF 14V 18V AUTO		LNB voltage
lof1		-40000.000 .. 40000.000	MHz	Low band LO frequency (negative values indicate LO > RF frequency)
lof2		-40000.000 .. 40000.000	MHz	High band LO frequency (negative values indicate LO > RF frequency)
mmod		OFF C/N C/N0		C/N Measurement mode
msbw		6 12 30 100		Measurement bandwidth
nois	r/o	-999.99 .. 0	dBm	Noise level, only valid in C/N modes
note		59 characters max.		The title of the readings web page
novl		OFF ON		Novella emulation
pwda		character string		Admin password
pwdu		character string		User password

rel2		LEVEL FTRACK		Relay 2 function
rxpl		H V		Polarization
sact	r/o	0 .. 1		Signal search active
scmp		user defined		Spectrum compensation
sdly		0 .. 600	sec	Signal search delay
sflt	r/o	OK FAULT		Synth fault
sfrc		1		Force signal search
srno	r/o	character string		Device serial number
ssen		OFF ON		Signal search enable
sver	r/o	character string		Software version
temp	r/o	-40 .. 50	C	Temperature
tflt	r/o	OK FAULT		Threshold fault
thrh		-999.99 .. 0	dBm	Alarm threshold
udpa		xxx.xxx.xxx.xxx		UDP destination address

4.5 One line read via TCP/IP

For compatibility with the ***sat-nms*** power sensor, the beacon receiver also may be polled for an automated monitoring by the requesting the 'read' document with a HTTP GET command. Assuming the receiver listens to the IP address 10.0.0.1, the complete URL for the request is:

http://10.0.0.1/read?fmt=txt

The 'fmt=txt' parameter forces the power sensor to reply a one line text document rather than the HTML coded page which is normally displayed by the web browser.

The beacon receiver answers a 'text/plain' type document which consist of one line. As shown in the example below, the line consists of a set of keyword - value pairs, separated by '&' characters. Within each pair, keyword and value are separated by the '=' character.

levl=-58.33&cton=8.33&c2n0=44.32&fofs=-3&adcv=12345&temp=22.5&tflt=OK&fflt=OK&sflt=OK&dflt=OK&sact=0

The format does not use fixed column widths for the values, however the precision of floating point values is always as shown in the example. An application which parses this string should not rely on the order of the values in the line. Future version of the receiver may provide additional values which not necessarily will appear at the end of the line. A description of the parameters is given in the chapter Parameter list above.

4.6 UDP level distribution

Polling the beacon receiver by means of HTTP GET requests via the network interfaces is limited in speed. The beacon receiver may be polled about three times a second this way. For step track application this may be too slow.

To overcome this limitation, the beacon receiver provides the capability to distribute the measured level or c/n value as UDP datagrams. It does this in real time as the values are sampled by the beacon receiver (8 samples per second). The ***sat-nms*** ACU/ODM uses this feature.

Protocol Definition

The UDP datagrams are sent to a configurable IP address at port 2000. Each datagram carries the actual measurement value as a zero-terminated string. Hence, if the beacon receiver is configured to make plain level measurements, the UDP datagrams contain something like '-65.33' which represents the measured

level in dBm. In C/No mode, the C/No values is contained in the UDP datagram: e.g. '12.33' for this dBHz value.

UDP datagrams are sent each time the beacon receiver measures the input level. During frequency track or while it performs a noise reference measurement, the beacon receiver pauses sending UDP datagrams.

Configuration

To use the UDP feature, enter a valid IP address to the "UDP destination address" field at the Setup page or set this parameter from remore with the 'udpa' remote parameter. If you want to use the beacon receiver together with a ***sat-nms*** ACU/ODM, set this parameter to the IP address of the ACU.

The beacon receiver starts to send UDP datagrams as soon as it receives a valid destination IP address. To stop the UDP distribution, set the destination address value to 'none'.

Beside definite IP addresses, the beacon receiver also accepts UDP broadcast masks for the "UDP destination address" parameter. In this case, the beacon receiver sends the datagrams as UPD broadcasts, multiple clients may receive the measurement value in this mode. When usinf UDP broadcasts you should consider the following:

- Other computers in the same network which listen to UDP datagrams at port 2000 may be disturbed by the data send by the beacon receiver.
- You must not enable UDP broadcasts for more than one beacon receivers in a network. Receivers of the UPD messages might fail to distinguish the messages coming from different beacon receivers.
- IP routers, also some sorts of switches deny to forward UPD broadcasts unless they are explicitly configured to do so.

4.7 Novella protocol emulation

The ***sat-nms*** beacon receiver provides a Novella remote protocol emulation on the serial RS232 interface. To enable this mode, at the Setup page set the 'Novella emulation' setup parameter to 'ON'. At the same place you set the protocol address 'A' ... 'G' (NONE makes no sense as the Novella receiver does not support a plain terminal protocol).

The Novella protocol emulation replicates the 'operational' parameters of the Novella receiver, They are in particular:

'S'	status request	The receiver replies with the Novella status string 'RFxxxxxxxyyyz' in the given protocol frame. 'RF' at the beginning states that the receiver is in remote mode. 'xxxxxxxx' is the actual receive frequency in kHz, using a fixed format with leading zeroes. 'yyy' signals the actual receive level as a 3 digit hexadeciamal number. The value 000 - fff resembles the analog output voltage (0..10V) of the receiver. You may use the appropriate setup parameters to scale the output for your needs. Finally, the last character reports the summarized fault status of the receiver. An asterisk ('*') reports a fault, the underscore character ('_') stands for OK.
'L'	set local	Sets the device to local mode. The ***sat-nms*** receiver does not distinguish between local and remote states. It ingores the command and replies it like the Novella receiver with the statrus string described above.
'R'	set remote	Sets the device to remote mode. The ***sat-nms*** receiver does not distinguish between local and remote states. It ingores the command and replies it like the Novella receiver with the status string described above.
'F'	set frequency	With this command the receivers frequency is set. The letter F must be followed by the receive frequency in kHz, formatted as an integer value, 8 digits with leading zeroes. Unlike the Novella L-band device, the ***sat-nms*** beacon receiver applies the the LO frequencies set at the setup page to this value. If you want to resemble the Novella receiver exactly, set the LO frequencies to zero.

Other commands are rejected as 'unknown command' by the ***sat-nms*** receiver.

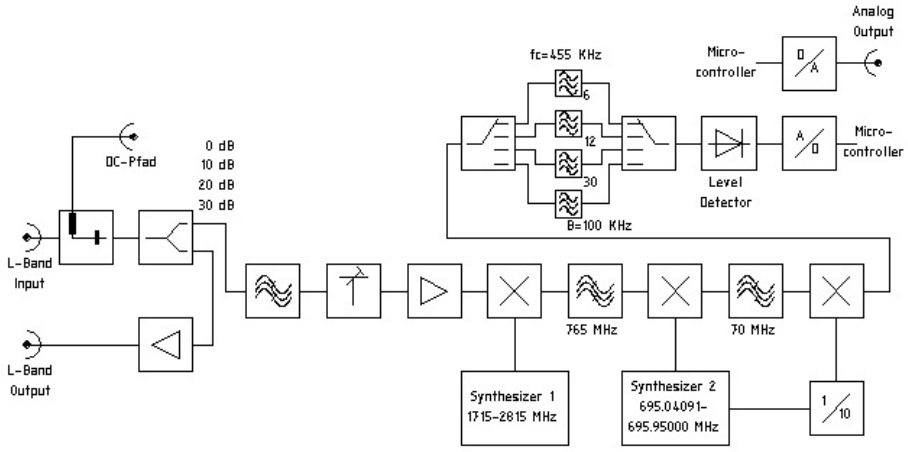
5 Theory of Operation

The beacon RX receives a satellite beacon signal which is down-converted to L-Band by a PLL stabilized Low Noise Converter (LNC) at its L-band interface input. The beacon RX does not demodulate any satellite because the satellite signals are sometimes CW signals but also very often modulated in FM or BPSK form. Due to this fact the best implementation is a non-coherent receiver which measures the input level in a user selectable defined bandwidth and provides this as a dB-linear and calibrated analogue output voltage and digital information.

The level output is provided by three different and parallel available interface types: a HTTP Web Interface via an internal Web Server, a RS232 interface or the analog voltage output. The ***sat-nms*** beacon receiver is controlled remotely by a monitoring and control application through the TCP/IP interface. All communication with the power sensor is made with HTTP get requests. The beacon receiver implements the Hypertext Transfer Protocol (HTTP, RFC-1945) both, for the user interface and for the M&C interface.

5.1 Receiver Design

The following block diagram shows the functional blocks of the ***sat-nms*** L-Band Beacon Receiver.



The L-band input signal is applied to the SMA connector X1. The receive frequency range is from 950MHz to 2050MHz. A small portion of the input signal is coupled out of the main signal flow, the coupling is compensated by a small amplifier and this signal is provided as a L-band test output signal with the same output level at the L-Band test output SMA connector with the same power level for test and measurement purposes. The L-band signal is filtered within a 950 to 2050MHz filter and then attenuated by a programmable attenuator in steps of 0dB, 10dB, 20dB or 30dB. After this programmable attenuator a first amplifier with approximately 20dB of gain and a noise figure of 3.5dB amplifies the signal for the first down conversion in a 13dBm mixer. This mixer converts the L-band input signal to the first IF of 765MHz by use of a PLL frequency synthesizer. This mixer is highly linear and determines the overall dynamic range of the system.

The 765MHz signal is then filtered by use of two 3-pol. ceramic filters which attenuates the out of receive channel signals. After these two filter stages the 765MHz signal is converted by a second mixer to a 70MHz IF by use of the fractional-N synthesizer. Direct behind the mixer a SAW filter with approximately 300kHz bandwidth is used to filter the 70MHz signal. This filter has a very high Q so that only frequencies inside the bandwidth will be fed to the last mixer circuit.

This mixer converts the 70MHz IF into the final 455kHz IF by use of 1/10 the frequency of the fractional-N synthesizer. The 455kHz IF signal is the fed into a one of four analog multiplexer circuit. Via the internal micro controller the appropriate bandwidth of 6, 12 30 and 100KHz is selectable. The 6, 12 and 30KHz filters are ceramic filters the 100kHz filter is due to the high relative bandwidth a discrete filter with inductors and capacitors. OP-amps behind the filters are used to match the filters with the appropriate impedance and

are used to provide almost the same level as at the multiplexer input. In a last gain stage the 455kHz signal is amplified to the appropriate level for the level detector.

The signal level is measured with an logarithmic amplifier. This level detector has a very high dynamic range and is also very linear. Output of the level detector is a D/C voltage proportional to the L-band input power. This voltage is converted into a 16bit digital word by an analogue to digital converter with 16bit resolution.

A on board temperature sensor gives the beacon receiver M&C board the knowledge about the temperature on the RF circuit board and allows fro temperature compensation.

D/C-input to the beacon receiver is +24V/0.5A provided by the M&C board.

There are two D/C-D/C converters on the board to convert the +24V D/C into +6V for the analog +5V supply and the digital +3.3V / +5V. The digital D/C voltage regulator provides a DC_ERROR signal which can be read back to the M&C board.

The 2nd D/C-converter is used for the LNB supply which can be programmed either to 14V or 18V. Furthermore this LNB voltage can be modulated by the Diseq_22kHz signal to provide a DiseqC interface. The DiseqC interface is not implemented in the first design stage but the hardware basis is given with this circuit design and the real DiseqC implementation is later on a question of software in the microcontroller on the beacon receiver M&C board. At the moment only a 22KHz signal is generated if necessary

In cases where no LNB supply is needed the D/C converter can be switched off by the LNC_ON signal.

In order to reduce interference from the microcontroller to the RF part and also to reduce cost on the PC board production the circuit for the monitoring and control of the L-Band beacon receiver is designed on a second printed circuit board.

The main interface to the beacon receiver RF board is via the SPI interface. This means that the analog to digital converter, the temperature sensor and also all monitoring and alarm input and output ports are placed on the RF board and the digital information is routed via the SPI bus to the M&C board and its microcontroller.

In addition to that the following interface is provided, the output of the logarithmic detector provides a analog output voltage which can be used via two interfaces:

- Analog output
- Output via 16bit analog to digital converter

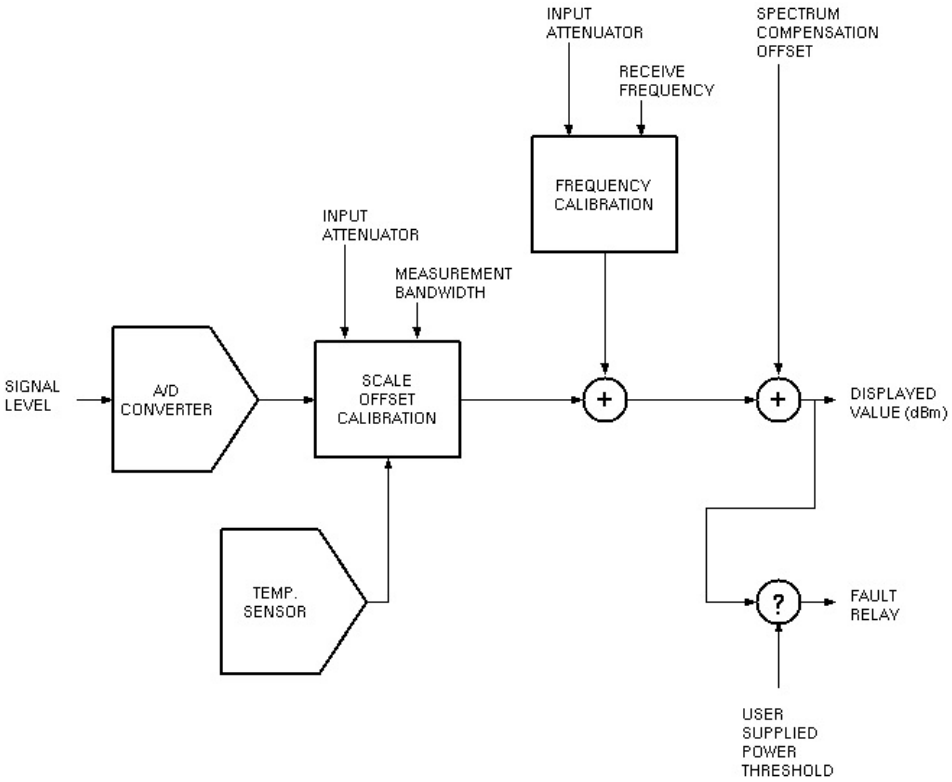
The analog output voltage is provided to allow the receiver to interface with other manufacturers antenna control units. The analogue output voltage is generated in the microcontroller in digital form. This does have the big advantage that all temperature, linearity and slope compensation is also valid for the analogue output voltage. Also the slope in dB/V and the input level which generates 0V analogue output voltage can be set via the web browser interface. Via this connector other vendors antenna control units can receive their beacon level input signal as analog voltage connected to their analog to digital converter in the ACU. The SMA connector was selected due to space reasons, as a BNC did not fit on the interface side of the L-Band beacon receiver housing.

This microcontroller controls also the synthesizer and the other hardware selections like bandwidth control. The microcontroller does provide also a TCP/IP Ethernet port and provides all necessary monitoring & control data as web interface via HTTP protocol. This allows an easy interfacing with the antenna control unit.

5.2 Processing of Measured Values

The logarithmic detector circuit outputs a dB-proportional voltage to the A/D converter. Hence the measured ADC samples reflect directly the receiver's input power in dBm. The readings however are subject to vary by temperature. There is an absolute offset which changes with the temperature, but also the dB to voltage relation slightly may change.

The beacon receiver software compensates this effect by varying the scale and offset values used to compute the dBm value from the ADC reading. During the factory tests each beacon receiver gets calibrated at several temperatures. The data processing of the receiver software then works as described below:



5.3 C/N Measurement

In addition to the normal level measurement, the ***sat-nms*** LBRX beacon receiver is able to perform C/N measurements. This is done by measuring the level of the received noise at a frequency other than the receive frequency in regular intervals. Each measured signal level then gets converted to a C/N value by referring it to the noise level value. While the receiver measures the noise level, it freezes the displayed C/N value as well as the analog output voltage for this time.

The behavior of the C/N measurement function is controlled by three operational parameters:

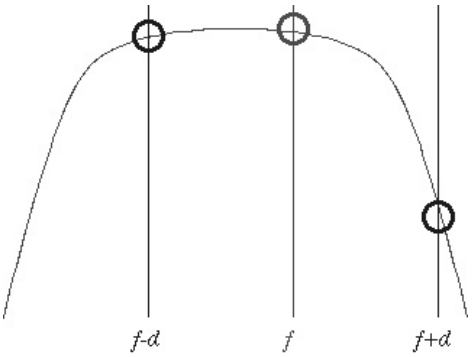
Parameter Name	*Remote Command*	*Description*
C/N Noise measurement	**mmod**	This parameter controls if the receiver shall perform a plain input level measurement or a C/N measurement. The following measurement modes are available: **OFF** The receiver performs a plain level measurement. The Readings page shows the input level in dBm. **C/N** The receiver measures the signal / noise ratio. The Readings page shows the C/N in dB. **C/N0** Like the C/N mode, but the receiver normalizes the C/N value to 1 Hz measurement bandwidth. The Readings page shows the C/N0 in dBHz.
Noise Measurement Frequency	**cnmf**	This parameter specifies the frequency at which the receiver shall measure the noise level at a certain interval. Like with the receive frequency, the LO frequency settings made at the Setup page are taken into account also for this

		frequency value. To get reasonable results with a C/N measurement, you should consider the following: 1. The receiver does not change the LNB frequency band setting when it switches from the level measurement to the noise measurement. The L N B probably would change it's gain in this case. The noise measurement frequency hence must be in the same frequency band as the receive frequency. 2. Measuring the noise level at the band edge may falsify the result due to the LNB's band filter. The measured noise level may be too low in this case. 3. You should verify with a spectrum analyzer, that no signal disturbs the noise measurement at the selected frequency.
Noise Measurement Interval	**cnmi**	This parameter defines the interval at which the receiver inserts noise measurements in the C/N modes. The time is specified in seconds. 3600 secs being one hour is a suitable setting in most cases.

5.4 Frequency Tracking

The ***sat-nms*** LBRX beacon receiver using it's non-coherent receiver design, does not automatically follow an input signal drifting in frequency like a PLL receiver would do. To let the receiver compensate effects like an LNC frequency drift due to temperature or Doppler frequency shift, a frequency tracking algorithm has been implemented in the receiver.

With frequency tracking enabled, the receiver tunes the receive frequency a small amount up and down at certain intervals. Such a search step takes less than one second, while the frequency is detuned, the level reading and the analog output of the receiver stays frozen.



The step size used for a frequency search step depends in the measurement bandwidth, the receiver automatically selects the appropriate step size. Receiving a C/W signal, the receiver software expects a signal degradation of 1..3 dB when the frequency has been tuned up or down. The receiver evaluates the signal center frequency by comparing the measured level, at the old frequency *f*, at *f+d* and *f-d* to the known shape of the filter.

The behavior of the frequency track facility is controlled by three operational parameters:

Parameter Name	*Remote Command*	*Description*
Frequency Tracking	**ftrk**	This parameter switches the the frequency tracking facility of the receiver ON or OFF. Please note, that switching off the frequency tracking does not reset the frequency offset which is applied by the frequency tracking. To reset the offset, set the receiver's frequency setting.

Frequency Tracking Interval	**ftri**	This parameter sets the interval on which the frequency tracking procedure operates. The value is in seconds. Recommended settings are 15 seconds to tune the receiver quickly to a frequency you do not know precisely. For normal operation a frequency tracking interval of one hour (3600 secs) is recommended.
Frequency Tracking width	**ftrw**	With this setting you limit the frequency offset the frequency tracking procedure may apply to the nominal frequency. The frequency tracking never tunes the receiver to a frequency outside the specified range, a frequency track fault is generated if the tracked frequency reaches the limit.

5.5 Signal search

The 'signal search' function enables the receiver to search a signal within the frequency tracking width. A signal search is triggered either manually or automatically if the signal disappears for a certain time. The beacon receiver monitors the 'threshold fault' to detect if the signal is present.

When a signal search is initiated, the receiver steps over the frequency range from *f-ftrw* to *f+ftrw* in steps of *0.8 msbw*. The receiver detects at which frequency the highest level is achieved and finally tunes the receiver to this frequency. The frequency offset of the frequency tracking is adjusted for this, the nominal frequency remains unchanged. The duration of the search cycle depends on the bandwidth an tracking range settings, the maximum expected value (bw=6kHz, range = +/- 150kHz) is 1 minute.

The behavior of the frequency track facility is controlled by the following operational parameters:

Signal search enable	**ssen**	Setting this parameter to ON enables the automatic signal search function. If the input signal falls below the alarm threshold for a certain time, a signal search is initiated.
Signal search delay	**sdly**	This parameter defines the time, the receiver waits after the signal was lost until a search scan is started. The valid range of this parameter is 0 .. 600 seconds.
Alarm threshold	**thrh**	The threshold value which primarily is used to generate a 'signal missing' fault is very important for the signal search function. If the measured input level falls below this threshold for at least *sdly* seconds, a search cycle is triggered. You must sxet the threshold to a reasonable value in order to let the receiver detect that the signal is missing.
Frequency Tracking width	**ftrw**	This also parameter defines the frequency range which is covered by the search procedure. A search cycle always starts at *f-ftrw* and ends at *f+ftrw*.
Force search	**sfrc**	If a 1 is written to this parameter, the receiver immediately starts searching, regardles of the *ssen* setting. When operated at with a web browser, clicking to 'SEARCH NOW' executed this command. Reading back the *sfrc* parameter always returns an empty string.

If the receiver is tuned to a new frequency while the signal search function is enabled, the frequency offset is set to 0 and the receiver operates at this frequency for *sdly* seconds. If the received signal stays below the threshold during this time, the receiver starts searching.

After a search cycle has been finished, the receiver is tuned to that frequency which gave the highest level during the search. If after a short delay for signal settling the receive level still is below the threshold, the next search cycle starts immediately.

The signal search operates in steps of approx. 80% of the measurement bandwidth. This is to make the search procedure as fast as possible. The signal frequency therefore is not determined very accurately. If you have enabled the frequency tracking function at the same time, the receiver performs a frequency track cycle directly after the signal search. If frequency tracking is switched off, the receiver tuning is left at the frequency offset the search alorithm has found.

6 Specifications

The table below summarizes the beacon receiver's specifications:

RF Specification	
Input frequency range	950 to 2050 MHz
Frequency Step Size	1 KHz
L-Band Input Connector	SMA female 50 Ohm
LNC voltage	OFF/14/18V
L-Band Test Output Connector	SMA female 50 Ohm
Input Noise Figure	< 10dB
Frequency accuracy	1*E-6
Input Level measurement range	-40 dBm to -80 dBm
Measurement bandwidths	6, 12, 30 and 100 KHz
Output Voltage range of analogue AGC voltage	0V to 10V
Slope of analog output voltage	programmable, -5.0 .. +5.0 V/dB
0V point of analog output voltage	programmable, -200 to 0 dBm
Output Connector for analog output voltage	SMA female
Linearity failure	+/-1dB in any 10 dB
Switchable input attenuator to adapt the dynamic range and input signal level	0, 10, 20, 30 dB
Video bandwidth selectable by micro controller	0.1 Hz, 0.5 Hz, 1 Hz, 5 Hz
Large signal behavior	no impact at -35dBm total input power
Digital frequency tracking functionality	programmable +/- Bandwidth
M&C Interface Specification	
Ethernet interface for M&C and user interface	10-Base-T, Via HTTP GET requests
RS232 M&C Interface	D-SUB 9 female,
Summary fault indication	Photo MOS relay contact D-SUB 9 male (120 V D/C, 100 mA)
Level alarm indication or frequency tracking alarm	Photo MOS relay contact D-SUB 9 male (120 V D/C, 100 mA)
Electrical and Mechanical Specification, Environmental conditions	
Supply Voltage	22 V to 28 V unregulated D/C
Temperature range	5 to 50 C
Humidity	up to 90% non condensing
DIN rail module	270 x 105 x 50 mm
Rack mount LBRX19	19" x 1HU x 370mm
Weight DIN rail module	1,5 kg
Weight rack mount LBRX19	5.0 kg